To Roger.
Sincerely, M.J. Horning
1/31/89

Table 1. Site classification for 29 Douglas-fir seed orchards sampled during 1983-1987 cone years.

Orchard[1]	Physiographic province[2]	Adjacent land use	Year Sampled '83	'84	'85	'86	'87
Badger Hill	Sierra Nevada	Forest	X	X	X		
Beaver Creek	Coast Range	Forest	X	X	X		X
Camas Prairie	Coast Range	Forest					X
Captain Moses	Northern Cascades	Forest	X		X		
Dennie Ahl	Olympic Peninsula	Forest	X		X	X	X
DNR	Puget Trough	Nonforest			X		
Elk Creek	Coast Range	Forest			X		
Elkton	Coast Range	Forest		X	X	X	X
Eola Hills	Willamette Valley	Nonforest	X		X		X
Fawn Lake	Puget Tough	Forest			X		
Gossard	Coastal California	Forest		X	X	X	X
Heather	Western Cascades	Forest					X
Horning	Western Cascades	Forest	X		X	X	X
Little River	Coastal California	Forest		X	X		X
Logsden	Coast Range	Forest					X
McDonald	Coast Range	Forest	X	X	X		
Mason	Western Cascades	Forest	X	X	X	X	X
Mosby Creek	Western Cascades	Forest	X		X		X
Olsen Creek	Puget Trough	Forest(?)					X
Research Center	Willamette Valley	Nonforest					2X
Springfield Block			X		X		
Toledo Block			X	X	X	X	
Coquille Block				X	X	X	
Rochester	Puget Trough	Nonforest	X	X	X	X	
Row River	Western Cascades	Forest	X	X	X		X
Schroeder, J. E.	Willamette Valley	Nonforest	X	X	X	X	X
Sequim	Olympic Peninsula	Nonforest	X	X	X		X
Cascade Block					X		
Twin Harbor					X		
Coos Bay Block					X		
Everett Block					X		
Longview Block					X		
Sierra	Sierra Nevada	Forest					X
Sixes	Coast Range	Forest	X	X	X	X	2X
South Sound	Puget Trough	Nonforest	X		X		
Turner	Willamette Valley	Nonforest		X	X	X	X
Widby Island	Puget Trough	Nonforest					X

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[1] Orchard names as they appear in Anon. (1982).

[2] Defined by Franklin and Dyrness (1973) for orchards in Washington and Oregon. Badger Hill, Gossard and Little River designations made by authors.

Table 2. Results of dissections of cones from Douglas-fir seed orchards in the western United States: 1983-1987[1,2]

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]			
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled	Empty	Other
Badger Hill	83	100	63.5(1.1)	33.5(1.2)	13.3(1.1)	1.9(0.5)	4.1(0.8)	2.1(0.3)	1.1(0.1)	6.9(0.9)	0.6(0.1)
Beaver Creek	83	100	63.7(1.5)	31.6(1.2)	21.5(1.4)	3.3(0.6)	1.6(0.4)	1.9(0.2)	0.9(0.1)	2.7(0.2)	0.2(0.0)
Captain Moses	83	100	57.6(1.0)	10.4(0.8)	29.6(1.3)	2.0(0.3)	2.3(0.5)	0.3(0.0)	3.6(0.3)	7.3(0.5)	2.1(0.1)
Dennie Ahl	83	100	57.3(1.2)	6.5(0.4)	17.5(1.2)	0.2(0.1)	0.3(0.2)	1.9(0.1)	22.2(1.0)	7.9(0.3)	0.8(0.0)
Eola Hills	83	100	70.8(1.4)	23.1(1.2)	6.1(0.9)	1.3(0.4)	0.6(0.2)	8.7(0.4)	11.0(0.5)	19.8(0.9)	0.4(0.0)
Horning	83	100	68.3(0.9)	10.2(0.7)	45.0(1.9)	2.2(0.6)	5.0(0.8)	0.7(0.1)	0.7(0.1)	3.5(0.5)	1.0(0.1)
McDonald	83	40	71.4(2.3)	30.6(2.3)	29.7(2.3)	4.2(0.9)	2.2(0.6)	1.8(0.3)	0.4(0.1)	2.5(0.5)	0.0(0.0)
Mason	83	150	62.2(1.0)	9.3(0.8)	35.7(1.3)	6.2(0.6)	7.6(0.6)	0.4(0.1)	0.8(0.2)	1.7(0.3)	0.4(0.1)
Mosby Creek	83	100	64.8(1.2)	23.6(1.0)	24.0(1.2)	4.7(0.5)	5.7(0.7)	2.4(0.3)	0.8(0.1)	3.5(0.4)	0.2(0.0)
Res. Ctr. (Toledo)	83	110	61.7(1.1)	20.6(0.9)	12.6(1.1)	2.0(0.4)	3.9(0.5)	5.7(0.3)	2.3(0.1)	14.2(0.8)	0.5(0.0)
Res. Ctr. (Springfield)	83	100	62.2(1.0)	11.0(0.8)	23.1(1.5)	2.5(0.5)	8.0(1.0)	5.2(0.4)	1.1(0.1)	10.6(0.8)	0.7(0.1)
Rochester	83	110	61.2(1.2)	14.3(1.4)	8.9(1.2)	0.3(0.2)	0.1(0.0)	0.2(0.0)	20.0(0.7)	16.8(0.6)	0.6(0.0)
Row River	83	100	64.3(0.6)	24.9(0.9)	31.9(1.1)	1.9(0.3)	3.1(0.5)	1.1(0.1)	0.2(0.0)	1.1(0.1)	0.1(0.0)
Schroeder	83	100	70.6(1.2)	13.4(0.9)	6.7(1.0)	0.8(0.4)	0.8(0.3)	8.2(0.3)	4.3(0.1)	35.5(1.1)	0.9(0.0)
Sequim	83	100	67.1(1.5)	7.5(0.8)	6.2(1.0)	0.1(0.0)	0.2(0.1)	1.3(0.0)	6.2(0.2)	45.4(1.3)	0.3(0.0)
Sixes	83	100	60.7(1.1)	11.7(0.9)	30.7(1.5)	6.1(0.8)	5.6(0.7)	1.3(0.2)	1.0(0.1)	4.3(0.5)	0.1(0.0)
South Sound	83	100	79.8(1.5)	24.2(1.0)	13.2(1.6)	0.8(0.3)	0.2(0.2)	4.8(0.2	13.6(0.6)	22.0(0.9)	1.3(0.1)

Table 2. Continued.

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]			
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled	Empty	Other
Badger Hill	84	95	57.9(1.6)	16.1(1.0)	3.9(0.7)	1.2(0.4)	3.9(1.1)	2.1(0.3)	12.6(1.7)	17.4(1.0)	0.5(0.1)
Beaver Creek	84	100	64.7(1.6)	12.6(0.8)	15.5(1.2)	1.0(0.5)	0.6(0.3)	4.9(0.4)	5.3(0.9)	24.3(1.3)	0.4(0.1)
Elkton	84	100	74.6(1.3)	8.6(0.8)	6.6(0.9)	0.4(0.3)	1.1(0.5)	2.1(0.4)	23.9(1.3)	31.1(1.4)	0.7(0.4)
Gossard	84	45	59.2(2.0)	13.8(1.2)	4.1(0.7)	0.1(0.1)	0.3(0.2)	6.4(0.9)	19.0(2.2)	15.3(1.5)	0.1(0.1)
Little River	84	100	58.0(1.4)	16.5(1.3)	3.9(0.5)	0.5(0.3)	1.0(0.3)	10.9(0.8)	6.7(0.6)	18.0(1.0)	0.5(0.1)
McDonald	84	45	57.3(2.0)	27.3(1.9)	4.7(0.6)	1.3(0.6)	1.4(0.5)	5.8(0.7)	2.5(0.4)	13.0(1.3)	1.3(0.3)
Mason	84	60	75.2(1.9)	6.9(0.7)	17.1(2.2)	0.0(0.0)	1.9(0.7)	3.2(0.6)	9.5(1.1)	36.3(2.1)	0.2(0.1)
Res. Ctr. (Toledo)	84	100	66.8(2.2)	9.6(0.8)	4.1(0.7)	1.3(0.5)	3.5(0.8)	5.0(0.5)	15.2(1.3)	27.7(1.4)	0.4(0.1)
Res. Ctr. (Coquille)	84	100	56.3(1.4)	11.4(1.0)	2.9(0.5)	0.1(0.1)	0.2(0.1)	4.1(0.5)	5.8(0.6)	30.0(1.3)	1.8(0.4)
Rochester	84	100	63.5(1.8)	15.7(0.9)	6.2(1.1)	0.9(0.3)	2.6(0.9)	3.3(0.5)	8.4(0.9)	25.5(1.3)	0.8(0.2)
Row River	84	95	64.5(1.5)	18.3(1.3)	9.6(1.0)	3.4(0.6)	0.5(0.4)	8.2(0.6)	4.7(0.6)	18.5(1.2)	1.3(0.3)
Schroeder	84	100	67.2(1.8)	3.9(0.5)	2.7(0.5)	0.2(0.1)	0.9(0.3)	0.5(0.1)	26.4(1.1)	32.3(1.4)	0.2(0.1)
Sequim	84	115	75.0(1.8)	11.0(1.3)	2.3(0.6)	0.0(0.0)	0.0(0.0)	0.4(0.1)	25.1(1.7)	35.3(1.5)	0.8(0.2)
Sixes	84	100	54.8(1.3)	14.6(1.1)	4.9(0.7)	0.2(0.1)	0.2(0.1)	3.1(0.5)	6.1(0.8)	24.3(1.4)	0.5(0.2)
Turner	84	105	59.2(1.3)	6.9(0.5)	2.7(0.6)	0.0(0.0)	0.0(0.0)	0.3(0.1)	23.0(1.6)	25.4(1.1)	1.1(0.3)

Table 2. Continued.

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]			
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled	Empty	Other
Badger Hill	85	50	60.8(2.0)	48.4(2.6)	4.0(0.9)	0.5(0.3)	3.7(1.5)	1.0(0.2)	0.3(0.1)	1.8(0.5)	0.0(0.0)
Beaver Creek	85	173	67.4(0.9)	17.8(0.8)	1.3(0.2)	0.0(0.0)	0.0(0.0)	1.1(0.1)	25.9(0.9) .38	20.8(0.6)	0.5(0.1)
Captain Moses	85	100	64.5(1.4)	19.1(1.2)	0.5(0.2)	0.0(0.0)	0.2(0.2)	0.2(0.1)	23.4(1.4) .36	20.7(1.0)	0.4(0.1)
Dennie Ahl	85	100	58.9(1.3)	5.6(0.4)	9.9(0.9)	0.3(0.1)	2.2(0.6)	0.5(0.1)	14.8(1.1)	25.0(1.2)	0.6(0.1)
DNR	85	104	67.8(1.8)	17.7(1.6)	0.8(0.2)	0.4(0.2)	0.2(0.1)	0.1(0.0)	12.5(0.9)	35.3(1.7)	0.9(0.3)
Elk Creek	85	100	61.0(1.6)	24.8(2.1)	2.0(0.5)	0.0(0.0)	0.7(0.3)	1.6(0.4)	20.5(1.8)	10.1(0.9)	1.2(0.4)
Elkton	85	100	82.4(2.0)	10.1(1.0)	1.8(0.6)	0.0(0.0)	0.2(0.1)	0.3(0.1)	.64 53.9(1.7)	15.5(1.0)	0.5(0.1)
Eola Hills	85	80	68.9(1.2)	5.3(0.7)	1.0(0.3)	0.0(0.0)	0.0(0.0)	0.1(0.1)	.52 35.7(1.7)	26.4(1.3)	0.3(0.1)
Fawn Lake	85	30	60.6(2.0)	9.3(1.3)	0.9(0.4)	0.3(0.3)	0.6(0.3)	0.0(0.0)	21.3(2.7)	27.9(2.3)	0.4(0.1)
Gossard	85	105	66.5(1.4)	8.6(0.9)	38.3(2.5)	0.4(0.2)	1.6(0.3)	2.3(0.3)	8.5(1.3)	6.4(0.7)	0.4(0.1)
Horning	85	125	65.2(1.2)	11.2(1.0)	1.5(0.4)	0.3(0.2)	0.8(0.3)	0.3(0.1)	.44 28.8(1.4)	21.8(1.1)	0.4(0.1)
Little River	85	100	59.8(1.3)	27.8(2.2)	1.9(0.5)	0.1(0.0)	2.1(0.6)	4.9(0.6)	12.9(1.4)	9.9(1.0)	0.3(0.1)
McDonald	85	40	70.0(1.7)	17.4(1.9)	1.5(0.7)	0.2(0.2)	0.3(0.2)	1.5(0.4)	16.3(1.6)	31.9(2.3)	0.9(0.2)
Mason	85	100	71.4(1.3)	13.8(1.2)	2.9(0.6)	0.0(0.0)	1.0(0.5)	0.5(0.2)	.34 24.4(2.6)	27.5(1.4)	1.4(0.2)
Mosby Creek	85	20	78.1(3.0)	31.4(3.7)	5.5(1.3)	0.0(0.0)	0.0(0.0)	2.3(0.9)	17.6(3.0)	20.7(2.2)	0.7(0.2)
Res. Ctr. (Toledo)	85	55	74.9(2.1)	12.1(1.1)	1.1(0.6)	0.0(0.0)	0.0(0.0)	0.1(0.1)	.41 30.5(3.0)	30.6(2.3)	0.5(0.2)
Res. Ctr. (Springfield)	85	15	68.9(3.5)	7.0(1.4)	36.9(6.3)	0.0(0.0)	0.0(0.0)	0.1(0.1)	6.3(1.4)	18.6(3.1)	0.1(0.1)

Table 2. Continued.

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]			
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled	Empty	Other
Res. Ctr. (Coquille)	85	100	63.8(1.4)	18.5(2.0)	0.7(0.3)	0.1(0.1)	3.0(0.9)	2.0(0.3)	17.5(1.6)	19.4(1.7)	2.6(0.6)
Rochester	85	100	57.8(1.0)	11.1(0.9)	0.1(0.1)	0.0(0.0)	0.1(0.1)	0.0(0.0)	19.2(1.3)	27.2(1.5)	0.2(0.1)
Row River	85	80	64.0(1.4)	17.8(1.2)	4.3(1.0)	0.0(0.0)	0.1(0.1)	7.2(0.7)	15.4(1.4)	18.6(0.9)	0.7(0.2)
Schroeder	85	100	76.7(1.7)	32.5(2.9)	0.4(0.2)	0.0(0.0)	1.0(0.7)	0.2(0.1)	19.7(1.7)	22.8(2.0)	0.2(0.1)
Sequim (Cascade)	85	110	73.9(1.7)	10.1(0.8)	0.8(0.2)	0.0(0.0)	0.0(0.0)	0.7(0.3)	31.1(1.8)	30.8(1.3)	0.3(0.1)
Sequim (Twin H.)	85	100	73.6(1.5)	16.4(1.2)	4.9(1.1)	0.1(0.1)	0.0(0.0)	0.0(0.0)	20.5(1.5)	31.9(1.4)	0.1(0.0)
Sequim (Coos Bay)	85	115	84.4(1.4)	17.3(1.4)	6.8(1.3)	0.0(0.0)	0.0(0.0)	0.1(0.1)	19.4(1.3)	40.6(1.6)	0.2(0.1)
Sequim (Everett)	85	95	75.1(1.8)	15.5(1.6)	6.6(1.6)	0.0(0.0)	0.0(0.0)	0.0(0.0)	16.4(1.5)	36.6(1.5)	0.1(0.0)
Sequim (Longview)	85	115	74.0(1.4)	9.8(0.9)	1.1(0.4)	0.0(0.0)	0.0(0.0)	0.0(0.0)	28.0(1.6)	33.6(1.4)	0.1(0.0)
Sixes	85	75	61.8(1.5)	28.0(2.4)	1.7(0.5)	0.1(0.1)	0.8(0.4)	0.9(0.3)	12.6(1.4)	17.5(1.6)	0.2(0.1)
South Sound	85	95	68.7(1.6)	14.5(1.0)	5.2(0.8)	1.1(0.3)	1.1(0.4)	0.7(0.1)	21.8(1.3)	23.9(1.5)	0.5(0.1)
Turner	85	100	63.4(1.5)	13.0(1.1)	1.1(0.5)	0.0(0.0)	0.0(0.0)	0.2(0.1)	25.6(1.9)	23.2(1.3)	0.3(0.1)

Table 2. Continued.

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]		
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled + Empty[7]	Other
Dennie Ahl	86	105	61.4(1.1)	12.2(0.8)	7.5(0.8)	0.0(0.0)	0.4(0.2)	0.5(0.1)	40.8(1.3)	0.0(0.0)
Elkton	86	92	76.0(1.4)	10.2(1.3)	48.8(2.8)	0.2(0.2)	6.3(1.0)	2.5(0.4)	6.7(0.9)	0.0(0.0)
Gossard	86	109	63.3(1.1)	7.0)0.7)	47.6(2.0)	0.0(0.0)	2.5(0.4)	0.3(0.1)	4.0(1.2)	2.0(0.8)
Horning	86	193	66.6(1.04)	14.1(0.7)	37.7(1.4)	0.0(0.0)	3.9(0.5)	0.5(0.1)	10.2(0.7)	0.0(0.0)
Mason	86	105	73.2(1.1)	15.0(1.2)	43.3(2.0)	0.0(0.0)	7.0(0.8)	2.0(0.3)	5.0(0.7)	0.1(0.0)
Res. Ctr. (Toledo)	86	60	60.4(1.4)	25.7(1.4)	24.0(1.9)	0.0(0.0)	2.8(0.8)	1.7(0.3)	5.9(0.5)	0.0(0.0)
Res. Ctr. (Coquille)	86	35	55.1(2.1)	24.4(2.5)	19.3(2.7)	0.0(0.0)	4.1(1.1)	1.1(0.3)	5.9(1.1)	0.0(0.0)
Rochester	86	95	66.1(1.4)	5.0(0.4)	0.1(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	61.1(1.5)	0.0(0.0)
Schroeder	86	100	72.1(1.2)	5.4(0.6)	5.9(1.2)	0.0(0.0)	0.7(0.4)	0.0(0.0)	59.9(1.9)	0.2(0.2)
Sixes	86	100	63.4(1.1)	22.7(1.4)	22.8(1.6)	0.0(0.0)	0.3(0.1)	1.0(0.2)	16.7(1.2)	0.0(0.0)
Turner	86	100	61.6(1.4)	14.0(1.1)	3.5(0.9)	0.0(0.0)	0.1(0.1)	0.1(0.0)	43.9(1.4)	0.0(0.0)

Table 2. Continued.

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]			
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled	Empty	Other
Beaver Creek	87	97	58.9(1.3)	9.0(0.7)	1.2(0.2)	0.2(0.1)	2.7(0.8)	2.0(0.3)	21.5(1.0)	19.2(0.9)	1.6(0.1)
Camas Prairie	87	99	73.9(1.5)	16.8(1.2)	8.4(1.2)	0.0(0.0)	0.0(0.0)	3.5(0.3)	16.2(1.1)	31.6(1.3)	0.9(0.1)
Dennie Ahl	87	100	65.9(2.0)	23.1(1.3)	10.6(0.8)	0.9(0.5)	0.4(0.2)	1.0(0.1)	16.7(1.0)	12.4(0.8)	0.9(0.1)
Elkton	87	99	78.9(1.8)	15.6(1.3)	23.1(1.9)	0.3(0.1)	0.9(0.3)	0.1(0.0)	25.9(1.6)	12.3(0.8)	0.7(0.1)
Eola Hills	87	100	64.9(1.5)	14.6(1.2)	0.8(0.3)	0.0(0.0)	0.0(0.0)	0.1(0.0)	34.4(1.4)	14.5(0.7)	0.3(0.1)
Gossard	87	100	60.2(1.3)	13.8(1.0)	19.1(1.9)	0.4(0.2)	1.2(0.3)	2.4(0.4)	14.2(1.4)	12.4(1.2)	0.5(0.1)
Heather(untreated)	87	43	57.5(2.1)	23.7(1.5)	17.6(1.7)	0.1(0.1)	2.0(0.7)	3.3(0.4)	6.0(0.7)	4.2(0.5)	0.5(0.1)
Heather(treated)	87	54	63.6(2.5)	28.9(1.9)	18.2(1.6)	0.2(0.1)	1.7(0.6)	3.3(0.3)	6.6(0.8)	3.9(0.4)	0.8(0.1)
Horning	87	99	63.0(1.8)	26.5(1.5)	24.1(1.4)	0.5(0.1)	2.4(0.5)	0.6(0.1)	3.7(0.3)	5.0(0.4)	0.2(0.0)
Little River	87	95	62.8(1.7)	14.3(1.4)	35.7(2.5)	0.0(0.0)	0.2(0.1)	2.6(0.3)	6.1(1.0)	4.9(0.5)	0.4(0.1)
Logsden	87	100	72.0(1.4)	20.5(1.5)	10.2(1.2)	0.0(0.0)	0.0(0.0)	0.0(0.0)	15.6(0.9)	23.6(1.1)	2.1(0.2)
Mason	87	98	59.5(1.3)	26.0(1.2)	20.9(1.3)	0.6(0.2)	4.5(0.6)	2.0(0.3)	1.2(0.3)	3.8(0.3)	0.6(0.1)
Mosby Creek	87	50	55.5(1.8)	27.8(2.2)	11.2(1.7)	0.0(0.0)	1.4(0.9)	3.2(0.4)	7.0(0.9)	4.8(0.6)	0.0(0.0)
Olsen Creek	87	98	65.6(1.7)	18.0(1.3)	28.1(2.0)	0.2(0.1)	6.1(0.8)	0.5(0.1)	2.5(0.3)	9.8(1.0)	0.3(0.0)
Res. Ctr. (Untreated)	87	50	76.6(1.7)	32.2(1.5)	15.5(1.7)	0.2(0.2)	2.1(0.7)	4.0(0.5)	7.6(0.8)	13.7(1.0)	1.4(0.2)
Res. Ctr. (Sprayed)	87	50	74.0(2.4)	25.7(1.8)	7.3(0.9)	0.0(0.0)	0.0(0.0)	1.9(0.2)	20.2(1.3)	18.3(1.0)	0.6(0.1)

Table 2. Continued.

Orchard	Year	Number of cones[3]	Total potential seed/cone[4]	Aborted ovules	Seed galled or eaten by			Extractable seed[5]			
					Contarinia[6]	Barbara	Dioryctria	Megastigmus	Filled	Empty	Other
Row River	87	50	56.1(1.6)	22.5(1.2)	7.6(0.8)	0.3(0.2)	0.6(0.4)	6.5(0.5)	9.2(0.9) .31	8.9(0.7)	0.4(0.1)
Schroeder	87	100	91.9(1.8)	15.5(0.8)	11.6(1.4)	0.6(0.3)	2.8(0.7)	0.7(0.1)	28.7(1.6)	31.0(1.2)	1.1(0.2)
Sequim	87	100	65.3(1.8)	23.1(1.1)	11.8(1.3)	0.0(0.0)	0.2(0.1)	0.3(0.0)	12.6(0.9)	17.0(1.2)	0.4(0.0)
Sierra	87	24	68.3(1.6)	20.9(1.3)	6.0(2.5)	1.0(0.9)	0.8(0.6)	0.0(0.0)	13.3(2.7)	25.8(2.4)	0.6(0.2)
Sixes (Untreated)	87	44	64.8(2.1)	18.4(1.1)	11.1(1.4)	0.1(0.1)	0.5(0.5)	2.7(0.4)	15.7(1.2)	15.8(0.8)	0.4(0.1)
Sixes (Sprayed)	87	55	64.9(1.7)	21.6(1.2)	4.0(0.6)	0.1(0.1)	0.4(0.4)	1.5(0.2)	16.7(0.9)	20.3(0.6)	0.4(0.0)
Turner	87	100	64.9(1.3)	14.8(1.1)	3.3(0.7)	0.0(0.0)	0.2(0.2)	0.0(0.0)	.42 27.2(1.3)	19.0(1.2)	0.3(0.0)
Widby Island	87	100	61.6(1.4)	3.3(0.6)	55.8(1.5)	0.1(0.1)	0.8(0.2)	0.0(0.0)	0.6(0.2)	2.1(0.7)	0.2(0.1)

[1] Mean (standard error) for all seed categories.

[2] Data for 1983 are derived from Tables 1 and 3 in Schowalter et al. (1985).

[3] Data result from the dissection of 10 cones from each tree in 1983 and 5 cones from each tree in the other years.

[4] Sum of all categories that follow.

[5] Includes only those seed actually extractable from the cones.

[6] Seed galled to the cone scales by Contarinia oregonensis. This includes filled seed, unfilled seed and seed infested by Megastigmus spermatrophus.

[7] Extractable seed which were filled and empty were not tallied separately in 1986.

Table 3. Number of seed destroyed by four insect species in Douglas-fir seed orchards in the western United States: 1983-1985, 1987[1]

Orchard	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Badger Hill	83	8.76	2.61	0.37	0.81	3.91	1.07
Beaver Creek	83	15.90	7.03	1.07	0.53	6.37	0.90
Captain Moses	83	14.11	8.48	0.56	0.66	0.76	3.66
Dennie Ahl	83	37.21	12.35	0.14	0.18	2.38	22.16
Eola Hills	83	23.58	2.36	0.50	0.22	9.53	10.97
Horning	83	14.11	8.14	0.40	0.91	3.97	0.71
McDonald	83	18.87	8.03	1.15	0.59	8.74	0.36
Mason	83	19.03	10.93	1.91	2.33	3.03	0.83
Mosby Creek	83	19.20	7.04	1.39	1.67	8.26	0.83
Res Ctr (Toledo)	83	14.44	2.85	0.45	0.88	7.98	2.29
Res Ctr (Springfield)	83	18.28	4.84	0.53	1.67	10.15	1.09
Rochester	83	25.25	4.79	0.18	0.04	0.21	20.04
Row River	83	20.95	9.49	0.57	0.93	9.80	0.15
Schroeder	83	14.59	1.14	0.14	0.14	8.91	4.25
Sequim	83	8.34	0.80	0.01	0.02	1.35	6.16
Sixes	83	16.64	7.48	1.48	1.36	5.36	0.97
South Sound	83	24.73	5.11	0.30	0.09	5.67	13.56

Table 3. Continued

Orchard	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Badger Hill	84	18.64	1.58	0.39	1.49	2.57	12.61
Beaver Creek	84	15.39	3.30	0.31	0.16	6.34	5.28
Elkton	84	29.50	2.58	0.21	0.42	2.39	23.90
Gossard	84	27.96	1.97	0.07	0.08	6.84	19.00
Little River	84	20.25	1.42	0.23	0.33	11.56	6.70
McDonald	84	11.64	1.17	0.61	0.44	6.91	2.47
Mason	84	16.53	2.75	0.00	0.31	3.80	9.50
Res. Ctr. (Toledo)	84	23.84	1.41	0.40	1.23	5.58	15.22
Res. Ctr. (Coquille)	84	10.57	0.48	0.04	0.05	4.21	5.80
Rochester	84	14.79	1.87	0.24	0.24	3.95	8.40
Row River	84	18.42	2.81	0.91	0.10	9.94	4.66
Schroeder	84	28.52	1.18	0.12	0.28	0.52	26.42
Sequim	84	26.29	0.81	0.00	0.00	0.37	25.10
Sixes	84	10.96	1.18	0.01	0.03	3.54	6.07
Turner	84	24.16	0.86	0.01	0.01	0.28	23.00

Table 3. Continued

Orchard	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Badger Hill	85	3.52	1.34	0.02	0.20	1.65	0.32
Beaver Creek	85	27.76	0.73	0.00	0.02	1.08	25.93
Captain Moses	85	23.87	0.23	0.00	0.04	0.23	23.38
Dennie Ahl	85	19.88	3.52	0.13	0.80	0.59	14.84
DNR	85	12.90	0.16	0.10	0.08	0.09	12.47
Elk Creek	85	23.71	1.34	0.00	0.28	1.62	20.48
Elkton	85	55.80	1.42	0.00	0.17	0.35	53.86
Eola Hills	85	36.37	0.53	0.01	0.01	0.13	35.70
Fawn Lake	85	21.99	0.41	0.04	0.28	0.00	21.25
Gossard	85	30.65	14.57	0.14	0.30	7.16	8.48
Horning	85	30.48	0.90	0.18	0.40	0.25	28.76
Little River	85	19.63	1.03	0.03	0.49	5.18	12.90
McDonald	85	18.54	0.57	0.00	0.12	1.48	16.27
Mason	85	26.56	1.23	0.00	0.45	0.52	24.36
Mosby Creek	85	22.26	2.21	0.00	0.00	2.45	17.60
Res. Ctr. (Tol.)	85	31.15	0.55	0.00	0.00	0.09	30.50
Res. Ctr. (Spr.)	85	15.19	8.07	0.00	0.00	0.87	6.26
Res. Ctr. (Coq.)	85	21.43	0.41	0.00	1.46	2.04	17.53
Rochester	85	19.23	0.03	0.00	0.01	0.00	19.18
Row River	85	24.85	1.98	0.02	0.08	7.41	15.36
Schroeder	85	20.92	0.19	0.00	0.82	0.23	19.68
Sequim (Cascade)	85	32.34	0.45	0.00	0.00	0.75	31.14
Sequim (Twin H.)	85	21.96	1.38	0.04	0.00	0.01	20.46
Sequim (Coos Bay)	85	20.95	1.37	0 00	0.00	0.13	19.44
Sequim (Everett)	85	17.33	0.93	0.00	0.00	0.00	16.39
Sequim (Longview)	85	29.10	0.30	0.00	0.00	0.00	28.80
Sixes	85	14.25	0.46	0.03	0.22	0.94	12.59
South Sound	85	26.37	2.83	0.53	0.51	0.73	21.78
Turner	85	26.66	0.88	0.00	0.00	0.23	25.56

Table 3. Continued

Orchard	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Beaver Creek	87	26.9	0.5	0.1	1.1	3.8	21.5
Camas Prairie	87	18.7	2.5	0.0	0.0	0.0	16.2
Dennie Ahl	87	24.5	6.0	0.4	0.2	1.1	16.7
Elkton	87	42.0	15.2	0.2	0.6	0.2	25.9
Eola Hills	87	35.2	0.6	0.0	0.0	0.1	34.4
Gossard	87	25.6	7.5	0.1	0.5	3.2	14.2
Heather(untreated)	87	23.0	9.9	0.1	1.2	5.9	5.9
Heather(treated)	87	23.0	9.7	0.1	1.1	5.8	6.6
Horning	87	16.1	9.8	0.2	1.1	1.4	3.7
Little River	87	26.0	14.6	0.0	0.0	5.3	6.1
Logsden	87	19.9	4.2	0.0	0.0	0.1	15.6
Mason	87	11.9	5.0	0.2	0.9	4.7	1.2
Mosby Creek	87	18.8	6.0	0.0	0.7	5.0	7.0
Olsen Creek	87	13.2	7.3	0.1	1.8	1.5	2.5
Res. Ctr. (Untreated)	87	19.0	5.4	0.0	0.8	5.2	7.6
Res. Ctr. (Sprayed)	87	25.9	3.7	0.0	0.0	2.0	20.2
Row River	87	21.0	3.7	0.1	0.3	7.8	9.2
Schroeder	87	36.7	5.7	0.4	1.1	0.8	28.7
Sequim	87	17.6	4.6	0.0	0.1	0.3	12.6
Sierra	87	14.5	0.9	0.1	0.1	0.0	13.3
Sixes (Untreated)	87	25.0	5.8	0.0	0.2	3.2	15.7
Sixes (Sprayed)	87	20.3	1.8	0.0	0.1	1.6	16.7
Turner	87	29.2	1.8	0.0	0.1	0.0	27.2
Widby Island	87	18.4	16.8	0.0	0.4	0.6	0.6

[1] Data were derived from the information in Table 2.

[2] The number of potential good seed/cone is the sum of the seed destroyed by insects and extractable good seed. It does not include aborted ovules, extracted empty seed, or unfilled seed eaten by insects.

[3] This value is the sum of the number of seed galled by Contarinia times the proportion of filled seed and half of the number of seed galled by Contarinia times the proportion of extractable seed infested by Megastigmus.

[4] This value is the sum of the number of seed eaten by Barbara times the proportion of filled seed and half of the number of seed eaten by Barbara times the proportion of extractable seed infested by Megastigmus.

[5] This value is the sum of the number of seed eaten by Dioryctria times the proportion of filled seed and half of the number of seed eaten by Dioryctria times the proportion of extractable seed infested by Megastigmus.

[6] This value is number of extractable seed infested by Megastigmus plus half of the seed galled or eaten by Contarinia, Barbara, and Dioryctria times the proportion of extractable seed infested by Megastigmus.

Table 4. Percent of seed destroyed by four insect species in Douglas-fir seed orchards in the western United States: 1983-1985, 1987[1]

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Badger Hill	83	8.76	32.8	4.0	7.7	44.0	11.6
Beaver Creek	83	15.90	42.1	6.6	2.7	41.5	7.0
Captain Moses	83	14.11	59.2	4.1	4.6	5.4	26.7
Dennie Ahl	83	37.21	33.1	0.6	0.4	6.4	59.5
Eola Hills	83	23.58	9.2	2.2	1.0	40.6	47.0
Horning	83	14.11	56.2	3.2	6.9	28.3	5.4
McDonald	83	18.87	41.1	6.1	2.5	47.8	2.5
Mason	83	19.03	56.8	10.0	12.7	16.0	4.6
Mosby Creek	83	19.20	36.4	7.3	8.5	43.3	4.5
Res Ctr (Toledo)	83	14.44	18.5	3.3	5.8	55.9	16.4
Res Ctr (Springfield)	83	18.28	25.7	2.8	9.1	56.1	6.2
Rochester	83	25.25	17.6	0.6	0.2	0.8	80.8
Row River	83	20.95	44.8	3.0	3.8	47.5	0.9
Schroeder	83	14.59	7.5	1.0	0.9	61.3	29.3
Sequim	83	8.34	9.2	0.2	0.3	16.2	74.1
Sixes	83	16.64	44.1	9.5	8.0	32.4	6.1
South Sound	83	24.73	18.8	1.5	0.3	23.2	56.3

Table 4. Continued

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Badger Hill	84	18.64	7.16	2.28	5.80	26.84	57.93
Beaver Creek	84	15.39	20.31	1.53	1.07	46.61	30.48
Elkton	84	29.50	9.34	0.66	1.29	10.04	78.67
Gossard	84	27.96	9.46	0.29	0.36	28.66	63.24
Little River	84	20.25	6.25	1.25	2.00	61.36	29.14
McDonald	84	11.64	9.98	3.74	2.74	61.23	22.31
Mason	84	16.53	17.34	0.00	2.06	22.71	57.89
Res. Ctr. (Toledo)	84	23.84	5.95	2.21	4.69	26.57	60.59
Res. Ctr. (Coquille)	84	10.57	5.13	0.44	0.39	41.86	52.19
Rochester	84	14.79	9.27	1.54	2.20	30.41	56.58
Row River	84	18.42	13.61	5.08	0.71	58.75	21.84
Schroeder	84	28.52	4.12	0.37	1.17	1.78	92.56
Sequim	84	26.29	3.69	0.00	0.00	1.55	94.77
Sixes	84	10.96	9.82	0.13	0.19	33.05	56.82
Turner	84	24.16	4.49	0.03	0.02	2.51	92.94

Table 4. Continued

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Badger Hill	85	3.52	23.9	0.4	5.1	57.8	12.8
Beaver Creek	85	27.76	2.6	0.0	0.1	4.4	92.9
Captain Moses	85	23.87	1.6	0.0	0.3	1.7	96.5
Dennie Ahl	85	19.88	17.1	0.5	3.2	5.6	73.7
DNR	85	12.90	1.0	0.6	0.3	1.1	97.0
Elk Creek	85	23.71	5.4	0.0	3.2	6.8	84.6
Elkton	85	55.80	2.4	0.0	0.3	0.7	96.6
Eola Hills	85	36.37	1.5	0.0	0.1	0.5	97.9
Fawn Lake	85	21.99	1.6	0.6	1.3	0.0	96.5
Gossard	85	30.65	44.2	0.3	1.3	26.0	28.3
Horning	85	30.48	2.7	0.6	2.2	1.1	93.4
Little River	85	19.63	5.8	0.2	3.2	29.7	61.1
McDonald	85	18.54	2.6	0.0	0.5	7.2	89.7
Mason	85	26.56	5.2	0.0	1.5	3.1	90.3
Mosby Creek	85	22.26	11.7	0.0	0.0	11.1	77.3
Res. Ctr. (Tol.)	85	31.15	1.6	0.0	0.0	0.2	98.2
Res. Ctr. (Spr.)	85	15.19	50.6	0.0	0.0	5.4	44.0
Res. Ctr. (Coq.)	85	21.43	2.1	0.0	5.7	16.9	75.4
Rochester	85	19.23	0.4	0.0	0.1	0.0	99.5
Row River	85	24.85	7.4	0.1	0.2	33.9	58.3
Schroeder	85	20.92	0.8	0.0	2.7	0.7	95.8
Sequim (Cascade)	85	32.34	1.2	0.0	0.0	3.6	95.3
Sequim (Twin H.)	85	21.96	8.1	0.1	0.0	0.0	91.8
Sequim (Coos Bay)	85	20.95	8.8	0.0	0.0	0.5	90.7
Sequim (Everett)	85	17.33	8.2	0.0	0.0	0.0	91.8
Sequim (Longview)	85	29.10	2.2	0.0	0.0	0.0	97.8
Sixes	85	14.25	4.6	0.4	1.3	5.2	88.6
South Sound	85	26.37	8.5	1.8	2.1	5.5	82.1
Turner	85	26.66	2.4	0.0	0.0	0.6	97.0

Table 4. Continued

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Beaver Creek	87	26.9	2.0	0.3	4.8	14.0	79.9
Camas Prairie	87	18.7	14.9	0.0	0.0	0.0	86.6
Dennie Ahl	87	24.5	25.4	1.2	1.1	5.2	68.2
Elkton	87	42.0	35.5	0.5	1.5	0.4	61.7
Eola Hills	87	35.2	1.5	0.0	0.0	5.1	97.7
Gossard	87	25.6	29.2	1.0	2.4	12.9	55.5
Heather(untreated)	87	23.0	41.8	0.8	5.4	26.0	25.7
Heather(treated)	87	23.0	41.7	0.6	4.1	26.1	28.7
Horning	87	16.1	60.1	1.4	5.5	8.6	23.0
Little River	87	26.0	49.1	0.1	0.1	25.7	23.5
Logsden	87	19.9	20.6	0.0	0.0	0.2	78.4
Mason	87	11.9	44.8	1.7	7.8	36.7	10.1
Mosby Creek	87	18.8	28.5	0.0	3.5	26.9	37.2
Olsen Creek	87	13.2	49.2	0.2	10.7	17.8	18.9
Res. Ctr. (Untreated)	87	19.0	28.7	0.3	3.4	29.8	40.0
Res. Ctr. (Sprayed)	87	25.9	15.5	0.0	0.1	8.5	78.0
Row River	87	21.0	19.7	0.7	1.7	38.2	43.8
Schroeder	87	36.7	14.6	0.8	3.8	2.4	78.2
Sequim	87	17.6	26.2	0.0	0.6	2.7	71.6
Sierra	87	14.5	6.2	2.0	1.7	0.0	91.7
Sixes (Untreated)	87	25.0	21.1	0.2	0.9	14.1	62.8
Sixes (Sprayed)	87	20.3	8.3	0.2	0.6	10.0	82.3
Turner	87	29.2	7.7	0.0	0.5	0.0	93.2
Widby Island	87	18.4	88.4	0.2	1.4	5.1	3.3

[1] Data were derived from the information in Table 3.

[2] The number of potential good seed/cone is the sum of the seed destroyed by insects and extractable good seed. It does not include aborted ovules, extracted empty seed, or unfilled seed eaten by insects.

Table 5. Number of seed destroyed by four insect species in Douglas-fir seed orchards in different geographic provinces in the western United States: 1983-1985, 1987[1]

Orchard by Physiographic Provence	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Northern Cascade							
Captain Moses	83	14.11	8.48	0.56	0.66	0.76	3.66
Captain Moses	85	23.87	0.23	0.00	0.04	0.23	23.38
Olympic Peninsula							
Dennie Ahl	83	37.21	12.35	0.14	0.18	2.38	22.16
Dennie Ahl	85	19.88	3.52	0.13	0.80	0.59	14.84
Dennie Ahl	87	24.5	6.0	0.4	0.2	1.1	16.7
Sequim	83	8.34	0.80	0.01	0.02	1.35	6.16
Sequim	84	26.29	0.81	0.00	0.00	0.37	25.10
Sequim (Cascade)	85	32.34	0.45	0.00	0.00	0.75	31.14
Sequim (Twin H.)	85	21.96	1.38	0.04	0.00	0.01	20.46
Sequim (Coos Bay)	85	20.95	1.37	0.00	0.00	0.13	19.44
Sequim (Everett)	85	17.33	0.93	0.00	0.00	0.00	16.39
Sequim (Longview)	85	29.10	0.30	0.00	0.00	0.00	28.80
Sequim	87	17.6	4.6	0.0	0.1	0.3	12.6
Puget Trough							
DNR	85	12.90	0.16	0.10	0.08	0.09	12.47
Fawn Lake	85	21.99	0.41	0.04	0.28	0.00	21.25
Olsen Creek	87	13.2	7.3	0.1	1.8	1.5	2.5
Rochester	83	25.25	4.79	0.18	0.04	0.21	20.04
Rochester	84	14.79	1.87	0.24	0.24	3.95	8.40
Rochester	85	19.23	0.03	0.00	0.01	0.00	19.18
South Sound	83	24.73	5.11	0.30	0.09	5.67	13.56
South Sound	85	26.37	2.83	0.53	0.51	0.73	21.78
Widby Island	87	18.4	16.8	0.0	0.4	0.6	0.6

Table 5. Continued.

Orchard by Physiographic Provence	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Coast Range							
Beaver Creek	83	15.90	7.03	1.07	0.53	6.37	0.90
Beaver Creek	84	15.39	3.30	0.31	0.16	6.34	5.28
Beaver Creek	85	27.76	0.73	0.00	0.02	1.08	25.93
Beaver Creek	87	26.9	0.5	0.1	1.1	3.8	21.5
Camas Prairie	87	18.7	2.5	0.0	0.0	0.0	16.2
Elk Creek	85	23.71	1.34	0.00	0.28	1.62	20.48
Elkton	84	29.50	2.58	0.21	0.42	2.39	23.90
Elkton	85	55.80	1.42	0.00	0.17	0.35	53.86
Elkton	87	42.0	15.2	0.2	0.6	0.2	25.9
Logsden	87	19.9	4.2	0.0	0.0	0.1	15.6
McDonald	83	18.87	8.03	1.15	0.59	8.74	0.36
McDonald	84	11.64	1.17	0.61	0.44	6.91	2.47
McDonald	85	18.54	0.57	0.00	0.12	1.48	16.27
Sixes	83	16.64	7.48	1.48	1.36	5.36	0.97
Sixes	84	10.96	1.18	0.01	0.03	3.54	6.07
Sixes	85	14.25	0.46	0.03	0.22	0.94	12.59
Sixes (Untreated)	87	25.0	5.8	0.0	0.2	3.2	15.7
Sixes (Sprayed)	87	20.3	1.8	0.0	0.1	1.6	16.7
Willamette Valley							
Eola Hills	83	23.58	2.36	0.50	0.22	9.53	10.97
Eola Hills	85	36.37	0.53	0.01	0.01	0.13	35.70
Eola Hills	87	35.2	0.6	0.0	0.0	0.1	34.4
Res. Ctr. (Coquille)	84	10.57	0.48	0.04	0.05	4.21	5.80
Res. Ctr. (Coquille)	85	21.43	0.41	0.00	1.46	2.04	17.53
Res Ctr (Toledo)	83	14.44	2.85	0.45	0.88	7.98	2.29
Res. Ctr. (Toledo)	84	23.84	1.41	0.40	1.23	5.58	15.22

Table 5. Continued.

Orchard by Physiographic Provence	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Res. Ctr. (Toledo)	85	31.15	0.55	0.00	0.00	0.09	30.50
Res Ctr (Springfield)	83	18.28	4.84	0.53	1.67	10.15	1.09
Res. Ctr. (Springfield)	85	15.19	8.07	0.00	0.00	0.87	6.26
Res. Ctr. (Untreated)	87	19.0	5.4	0.0	0.8	5.2	7.6
Res. Ctr. (Sprayed)	87	25.9	3.7	0.0	0.0	2.0	20.2
Schroeder	83	14.59	1.14	0.14	0.14	8.91	4.25
Schroeder	84	28.52	1.18	0.12	0.28	0.52	26.42
Schroeder	85	20.92	0.19	0.00	0.82	0.23	19.68
Schroeder	87	36.7	5.7	0.4	1.1	0.8	28.7
Turner	84	24.16	0.86	0.01	0.01	0.28	23.00
Turner	85	26.66	0.88	0.00	0.00	0.23	25.56
Turner	87	29.2	1.8	0.0	0.1	0.0	27.2
Western Cascades							
Heather(untreated)	87	23.0	9.9	0.1	1.2	5.9	5.9
Heather(treated)	87	23.0	9.7	0.1	1.1	5.8	6.6
Horning	83	14.11	8.14	0.40	0.91	3.97	0.71
Horning	85	30.48	0.90	0.18	0.40	0.25	28.76
Horning	87	16.1	9.8	0.2	1.1	1.4	3.7
Mason	83	19.03	10.93	1.91	2.33	3.03	0.83
Mason	84	16.53	2.75	0.00	0.31	3.80	9.50
Mason	85	26.56	1.23	0.00	0.45	0.52	24.36
Mason	87	11.9	5.0	0.2	0.9	4.7	1.2
Mosby Creek	83	19.20	7.04	1.39	1.67	8.26	0.83
Mosby Creek	85	22.26	2.21	0.00	0.00	2.45	17.60
Mosby Creek	87	18.8	6.0	0.0	0.7	5.0	7.0

Table 5. Continued.

Orchard by Physiographic Province	Year	No. potential seed/cone[2]	No. seed destroyed by				No. extractable good seed
			Contarinia[3]	Barbara[4]	Dioryctria[5]	Megastigmus[6]	
Row River	83	20.95	9.49	0.57	0.93	9.80	0.15
Row River	84	18.42	2.81	0.91	0.10	9.94	4.66
Row River	85	24.85	1.98	0.02	0.08	7.41	15.36
Row River	87	21.0	3.7	0.1	0.3	7.8	9.2
Coastal California							
Gossard	84	27.96	1.97	0.07	0.08	6.84	19.00
Gossard	85	30.65	14.57	0.14	0.30	7.16	8.48
Gossard	87	25.6	7.5	0.1	0.5	3.2	14.2
Little River	84	20.25	1.42	0.23	0.33	11.56	6.70
Little River	85	19.63	1.03	0.03	0.49	5.18	12.90
Little River	87	26.0	14.6	0.0	0.0	5.3	6.1
Sierra Nevada							
Badger Hill	83	8.76	2.61	0.37	0.81	3.91	1.07
Badger Hill	84	18.64	1.58	0.39	1.49	2.57	12.61
Badger Hill	85	3.52	1.34	0.02	0.20	1.65	0.32
Sierra	87	14.5	0.9	0.1	0.1	0.0	13.3

[1] Data were derived from the information in Table 2.

[2] The number of potential good seed/cone is the sum of the seed destroyed by insects and extractable good seed. It does not include aborted ovules, extracted empty seed, or unfilled seed eaten by insects.

[3] This value is the sum of the number of seed galled by Contarinia times the proportion of filled seed and half of the number of seed galled by Contarinia times the proportion of extractable seed infested by Megastigmus.

[4] This value is the sum of the number of seed eaten by Barbara times the proportion of filled seed and half of the number of seed eaten by Barbara times the proportion of extractable seed infested by Megastigmus.

[5] This value is the sum of the number of seed eaten by Dioryctria times the proportion of filled seed and half of the number of seed eaten by Dioryctria times the proportion of extractable seed infested by Megastigmus.

[6] This value is number of extractable seed infested by Megastigmus plus half of the seed galled or eaten by Contarinia, Barbara, and Dioryctria times the proportion of extractable seed infested by Megastigmus.

Table 6. Percent of seed destroyed by four insect species in Douglas-fir seed orchards in different geographic provinces in the western United States: 1983-1985, 1987[1]

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Northern Cascades							
Captain Moses	83	14.11	59.2	4.1	4.6	5.4	26.7
Captain Moses	85	23.87	1.6	0.0	0.3	1.7	96.5
Olympic Peninsula							
Dennie Ahl	83	37.21	33.1	0.6	0.4	6.4	59.5
Dennie Ahl	85	19.88	17.1	0.5	3.2	5.6	73.7
Dennie Ahl	87	24.5	25.4	1.2	1.1	5.2	68.2
Sequim	83	8.34	9.2	0.2	0.3	16.2	74.1
Sequim	84	26.29	3.69	0.00	0.00	1.55	94.77
Sequim (Cascade)	85	32.34	1.2	0.0	0.0	3.6	95.3
Sequim (Twin H.)	85	21.96	8.1	0.1	0.0	0.0	91.8
Sequim (Coos Bay)	85	20.95	8.8	0.0	0.0	0.5	90.7
Sequim (Everett)	85	17.33	8.2	0.0	0.0	0.0	91.8
Sequim (Longview)	85	29.10	2.2	0.0	0.0	0.0	97.8
Sequim	87	17.6	26.2	0.0	0.6	2.7	71.6
Puget Trough							
DNR	85	12.90	1.0	0.6	0.3	1.1	97.0
Fawn Lake	85	21.99	1.6	0.6	1.3	0.0	96.5
Olsen Creek	87	13.2	49.2	0.2	10.7	17.8	18.9
Rochester	83	25.25	17.6	0.6	0.2	0.8	80.8
Rochester	84	14.79	9.27	1.54	2.20	30.41	56.58
Rochester	85	19.23	0.4	0.0	0.1	0.0	99.5
South Sound	83	24.73	18.8	1.5	0.3	23.2	56.3
South Sound	85	26.37	8.5	1.8	2.1	5.5	82.1
Widby Island	87	18.4	88.4	0.2	1.4	5.1	3.3

Table 6. Continued

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Coast Range							
Beaver Creek	83	15.90	42.1	6.6	2.7	41.5	7.0
Beaver Creek	84	15.39	20.31	1.53	1.07	46.61	30.48
Beaver Creek	85	27.76	2.6	0.0	0.1	4.4	92.9
Beaver Creek	87	26.9	2.0	0.3	4.8	14.0	79.9
Camas Prairie	87	18.7	14.9	0.0	0.0	0.0	86.6
Elk Creek	85	23.71	5.4	0.0	3.2	6.8	84.6
Elkton	84	29.50	9.34	0.66	1.29	10.04	78.67
Elkton	85	55.80	2.4	0.0	0.3	0.7	96.6
Elkton	87	42.0	35.5	0.5	1.5	0.4	61.7
Logsden	87	19.9	20.6	0.0	0.0	0.2	78.4
McDonald	83	18.87	41.1	6.1	2.5	47.8	2.5
McDonald	84	11.64	9.98	3.74	2.74	61.23	22.31
McDonald	85	18.54	2.6	0.0	0.5	7.2	89.7
Sixes	83	16.64	44.1	9.5	8.0	32.4	6.1
Sixes	84	10.96	9.82	0.13	0.19	33.05	56.82
Sixes	85	14.25	4.6	0.4	1.3	5.2	88.6
Sixes (Untreated)	87	25.0	21.1	0.2	0.9	14.1	62.8
Sixes (Sprayed)	87	20.3	8.3	0.2	0.6	10.0	82.3
Willamette Valley							
Eola Hills	83	23.58	9.2	2.2	1.0	40.6	47.0
Eola Hills	85	36.37	1.5	0.0	0.1	0.5	97.9
Eola Hills	87	35.2	1.5	0.0	0.0	5.1	97.7
Res. Ctr. (Coquille)	84	10.57	5.13	0.44	0.39	41.86	52.19
Res. Ctr. (Coquille)	85	21.43	2.1	0.0	5.7	16.9	75.4
Res Ctr (Toledo)	83	14.44	18.5	3.3	5.8	55.9	16.4
Res. Ctr. (Toledo)	84	23.84	5.95	2.21	4.69	26.57	60.59

Table 6. Continued

Orchard	Year	No. potential seed/cone^2	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Res. Ctr. (Toledo)	85	31.15	1.6	0.0	0.0	0.2	98.2
Res Ctr (Springfield)	83	18.28	25.7	2.8	9.1	56.1	6.2
Res. Ctr. (Springfield)	85	15.19	50.6	0.0	0.0	5.4	44.0
Res. Ctr. (Untreated)	87	19.0	28.7	0.3	3.4	29.8	40.0
Res. Ctr. (Sprayed)	87	25.9	15.5	0.0	0.1	8.5	78.0
Schroeder	83	14.59	7.5	1.0	0.9	61.3	29.3
Schroeder	84	28.52	4.12	0.37	1.17	1.78	92.56
Schroeder	85	20.92	0.8	0.0	2.7	0.7	95.8
Schroeder	87	36.7	14.6	0.8	3.8	2.4	78.2
Turner	84	24.16	4.49	0.03	0.02	2.51	92.94
Turner	85	26.66	2.4	0.0	0.0	0.6	97.0
Turner	87	29.2	7.7	0.0	0.5	0.0	93.2
Western Cascades							
Heather (untreated)	87	23.0	41.8	0.8	5.4	26.0	25.7
Heather (treated)	87	23.0	41.7	0.6	4.1	26.1	28.7
Horning	83	14.1	56.2	3.2	6.9	28.3	5.4
Horning	85	30.5	2.7	0.6	2.2	1.1	93.4
Horning	87	16.1	60.1	1.4	5.5	8.6	23.0
Mason	83	19.03	56.8	10.0	12.7	16.0	4.6
Mason	84	16.53	17.34	0.00	2.06	22.71	57.89
Mason	85	26.56	5.2	0.0	1.5	3.1	90.3
Mason	87	11.9	44.8	1.7	7.8	36.7	10.1
Mosby Creek	83	19.20	36.4	7.3	8.5	43.3	4.5
Mosby Creek	85	22.26	11.7	0.0	0.0	11.1	77.3
Mosby Creek	87	18.8	28.5	0.0	3.5	26.9	37.2

Table 6. Continued

Orchard	Year	No. potential seed/cone[2]	Percent seed destroyed by				Percent extractable good seed
			Contarinia	Barbara	Dioryctria	Megastigmus	
Row River	83	20.95	44.8	3.0	3.8	47.5	0.9
Row River	84	18.42	13.61	5.08	0.71	58.75	21.84
Row River	85	24.85	7.4	0.1	0.2	33.9	58.3
Row River	87	21.0	19.7	0.7	1.7	38.2	43.8
Coastal California							
Gossard	84	27.96	9.46	0.29	0.36	28.66	63.24
Gossard	85	30.65	44.2	0.3	1.3	26.0	28.3
Gossard	87	25.6	29.2	1.0	2.4	12.9	55.5
Little River	84	20.25	6.25	1.25	2.00	61.36	29.14
Little River	85	19.63	5.8	0.2	3.2	29.7	61.1
Little River	87	26.0	49.1	0.1	0.1	25.7	23.5
Sierra Nevada							
Badger Hill	83	8.76	32.8	4.0	7.7	44.0	11.6
Badger Hill	84	18.64	7.16	2.28	5.80	26.84	57.93
Badger Hill	85	3.52	23.9	0.4	5.1	57.8	12.8
Sierra	87	14.5	6.2	2.0	1.7	0.0	91.7

[1] Data were derived from the information in Table 3.

[2] The number of potential good seed/cone is the sum of the seed destroyed by insects and extractable good seed. It does not include aborted ovules, extracted empty seed, or unfilled seed eaten by insects.